



2018 Water Quality Report
Fresh Pond Reservation: Class B Ponds, Cambridge, MA

The Cambridge Water Department monitors three ponds on the Fresh Pond Reservation: Little Fresh Pond, Black's Nook, and North Pond (figure 1). Water quality samples from each pond are collected quarterly. These shallow ponds have no surface water connections to the Fresh Pond water supply reservoir, and as such, they have negligible influence over water quality in the Cambridge water supply. Gated pipes between Little Fresh Pond and Fresh Pond Reservoir are kept closed under normal operating conditions but are opened as needed in controlled conditions to supply irrigation water to Little Fresh Pond. All three ponds drain the City of Cambridge Municipal Golf Course and the reservation's wooded areas, with overflow connections to the City's storm drain system. Stormwater in the developed areas surrounding the reservation is diverted away to further protect drinking water quality at Fresh Pond Reservoir. Groundwater communication between the ponds, the surrounding developed area, and the reservoir is minimized by keeping the reservoir elevation higher than the water table.



Figure 1: Fresh Pond Reservation Waterbodies



This report includes data from the reporting period of April 1, 2018 to March 31, 2019 (reporting year 2018).

Massachusetts Class B waters are designated for fish, other aquatic life and wildlife habitat, and for primary and secondary contact recreation. Class B water quality standards include numeric and narrative standards for dissolved oxygen, temperature, pH, bacteria, solids, color and turbidity, oil and grease, and taste and odor. In this study period, four dry-weather water quality sampling events were conducted. Samples were taken at the surface of each pond using extended poles or hand-grabbing samples after wading in from the shoreline. *In-situ* parameters were taken with a calibrated multi-probe concurrently with grab samples.

2018 Results

Black's Nook- Listed in the 2016 Massachusetts Integrated List of Waters as a Category 5 impaired water for transparency/clarity, nutrient/eutrophication biological indicators, and non-native aquatic plants. Historic and recent chlorophyll-*a* (chl-*a*) results are consistent with Carlson's trophic state index (TSI) for a highly-productive, eutrophic pond. Although median and average TSI numbers during reporting year 2018 were in the mesotrophic range, this was likely due to a low chl-*a* reading (chl-*a* <2 mg/m³) from the August sampling event which placed the pond in the oligotrophic zone (figure 2). The August chl-*a* results from LFP and North Pond were also uncharacteristically low at <2 mg/m³. These August results were very unusual since productivity is typically highest in the summer. Although laboratory records confirmed the reported low chl-*a* numbers, it was not possible to re-run the test to verify the results. As such, it is likely that these chl-*a* results were erroneous, artificially lowering the TSI statistics for the year.

1. Dissolved Oxygen (DO)

- Of the four surface DO measurements collected during the reporting period, one fell below the Class B standard (≥ 5 mg/L). Respiration from microbial organic matter decomposition and algae and plant growth likely contributed to the low DO concentration during the August summer sampling event.

Date	Time	Result
8/21/18	12:13 PM	3.16 mg/L

2. Temperature

- No violations associated with warm-water fisheries were observed. The Class B standard requires temperatures not to exceed 28.3°C.



3. pH

- No violations observed; $6.5 < \text{pH} < 8.3$.

4. Bacteria

- No violations observed. All *E. coli* samples were less than the Class B single sample water quality standard (< 235 colonies/100mL or most probable number (MPN)/ 100 mL for a single sample).

5. Solids

- There are no numeric criteria for solids, but visual observations suggest that neither floating nor suspended solids were an impairment for Black's Nook. However, the eutrophic state and dense aquatic plant growth limit the potential for swimming and boating (photograph A).

6. Color and Turbidity

- There are no numeric criteria for color and turbidity. However, the standard dictates that water bodies must be free from aesthetically objectionable conditions. CWD staff noted that the water looked visibly turbid with a greenish hue during the 4/24/2018 sampling event.

7. Taste and Odor

- No objectionable odors observed.

8. Oil and Grease

- No samples taken, but no visible oil and grease sheens observed.

Little Fresh Pond (LFP)- Not assessed as part of the 2016 Massachusetts Integrated List of Waters survey. Chl-*a* results were consistent with Carlson's trophic state index of a highly-productive, eutrophic and hypereutrophic pond (figure 2). As with Blacks Nook and North Pond, the 8/21/2018 chl-*a* result was likely erroneously low (chl-*a* $< 2 \text{ mg/m}^3$), resulting in an outlier TSI score for the event in the oligotrophic range. Shoreline restoration, vegetated buffers, and a pretreatment swale and forebay system were completed in 2008. Specific conductance readings and sodium and chloride concentrations are consistently among the highest of the reservation ponds (table 1). The values for these parameters closely mirror those of Fresh Pond Reservoir, reflecting the hydrological connectivity via pipes and groundwater communication.



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1. Dissolved Oxygen (DO)

- The August DO measurement fell below the Class B standard (≥ 5 mg/L). Respiration from microbial organic matter decomposition and algae and plant growth likely contributed to the low DO concentration. DO measurements from other quarterly sampling events remained above 5 mg/L.

Date	Time	Result
8/21/18	11:12 AM	3.34 mg/L

2. Temperature

- No violations associated with warm-water fisheries were observed. The Class B standard requires temperatures not to exceed 28.3°C.

3. pH

- No violations observed; $6.5 < \text{pH} < 8.3$.

4. Bacteria

- No violations observed. All *E. coli* samples were less than the Class B single sample water quality standard (< 235 colonies/100mL or most probable number (MPN)/ 100 mL for a single sample).

5. Solids

- There are no numeric criteria for solids, but visual observations suggest that neither floating nor suspended solids were an impairment for LFP. However, the eutrophic state and corresponding aquatic plant growth may limit the potential for swimming and boating.

6. Color and Turbidity

- There are no numeric criteria for color and turbidity. However, the standard dictates water bodies must be free from aesthetically objectionable conditions. CWD staff noted that the water looked visibly turbid with a greenish hue during the 4/24/2018 sampling event (photograph B).

7. Taste and Odor

- No objectionable odors observed.



8. Oil and Grease

- No samples taken, but no visible oil and grease sheens observed.

North Pond- Not assessed as part of the 2016 Massachusetts Integrated List of Waters survey. During the growing season, this pond fills with floating and rooted aquatic plants. The 2018-2019 chl-*a* results were consistent with Carlson's TSI for a highly-productive, eutrophic and hypereutrophic pond, with the same exception as Blacks Nook and LFP with regard to the low chl-*a* in August (figure 2). North Pond had the highest average and maximum TSI readings in the reporting period and was the most eutrophic of the three ponds (figure 2).

1. Dissolved Oxygen (DO)

- Of the four measurements collected during the 2018 reporting year, DO was less than the 5 mg/L Class B standard during the August and December sampling events. Respiration of algae and plants could account for the low DO, especially in August. Although low DO is less common in late fall since cold water can hold more DO than warm water and microbial respiration tends to slow down, the December chl-*a* level was 11.1 mg/m³. This corresponded to a TSI of 54 in the eutrophic range, indicating that the lake was still productive at that time of year.

Date	Time	Result
8/21/2018	11:42 AM	2.48 mg/L
12/4/2018	10:47 AM	1.35 mg/L

2. Temperature

- No violations associated with warm-water fisheries were observed; temperature remained below 28.3 degrees C.

3. pH

- No violations observed; all laboratory pH readings $6.5 < \text{pH} < 8.3$.
- On 2/6/2019, the *in-situ* pH measured by the water quality probe read 8.57 (above the Class B upper bound) while the pH of the water quality sample analyzed in the lab was only 6.94, within the Class B acceptable range. To collect the measurement and sample,



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CWD broke through approximately 5 inches of ice. The ice layer would have prevented atmospheric carbon dioxide from mixing with the pond water, thereby elevating the water pH. The lab pH reading was likely lower due to mixing with atmospheric carbon dioxide.

4. Bacteria

- No violations observed.

5. Solids

- There are no numeric standards for solids. Visual observations suggest that neither floating nor suspended solids were a source of impairment for the pond, except for the excessive vegetation and turbidity during the summer months discussed below.

6. Color and Turbidity

- Eutrophic state and water clarity discourage swimming and boating; during the summer, North Pond becomes choked with aquatic vegetation and suspended organic matter.
- Visibly turbid water with a green hue, likely from algae, was observed at North Pond during the 4/24/2018 sampling event (see Photograph C).
- Photographs D shows the dense aquatic vegetation in North Pond on 8/21/2018.

7. Taste and Odor

- No objectionable odors observed.

8. Oil and Grease

- No samples taken, but no visible sheens observed.



Photograph A: Blacks Nook, view looking northwest, showing dense macrophyte growth, on 8/21/2018.



Photograph B: LFP surface water with visible green turbidity, indicating algal growth, on 4/24/2018.





Photograph C: North Pond looking southwest, 4/24/2018. The water was turbid with a green hue. Aquatic macrophyte growth was minimal compared to August (photograph D below).

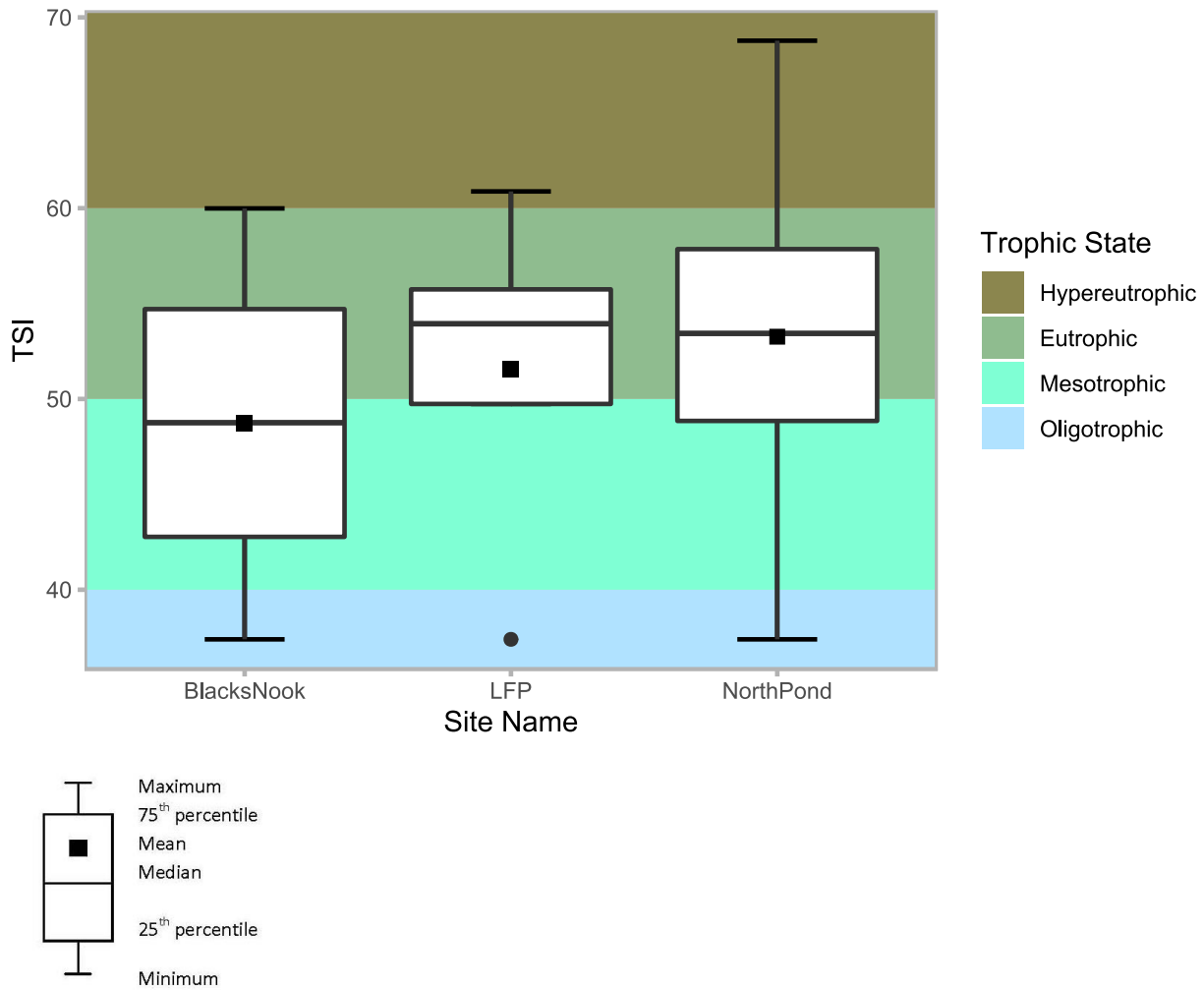


Photograph D: North Pond sampling location looking southwest, 8/21/2018. Dense aquatic vegetation and suspended organic matter were present throughout the pond.





Figure 2: Reservation Pond Trophic State Index from Chlorophyll-*a*, April 1, 2018 – March 31, 2019





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Table 1: Water Quality Results

Date	Site	Alkalinity (mg CaCO ₃ /L)	Al (mg/L)	Ca (mg/L)	Cl (mg/L)	Chl- <i>a</i> (mg/m ³)	Color (CU)	DO (mg/L)	<i>E. coli</i> (MPN/100 mL)	Fe (mg/L)	Lab pH	<i>In situ</i> probe pH	Mn (mg/L)	Na (mg/L)
4/24/2018	BlacksNook	43.5	0.03	15.7	21	9.76	24	11.22	12	0.66	7.65	8.02	0.065	10
4/24/2018	LFP	50.5	0.08	32.2	131	10.7	39	12.27	5	1.07	7.92	8.08	0.114	82
4/24/2018	NorthPond	106	0	36.9	25.6	9.48	61	6.34	1	1.37	7.36	7.55	0.212	14
8/21/2018	BlacksNook	45	0.04	14.3	18.2	<2	18	3.16	37	0.54	7.08	6.94	0.051	9
8/21/2018	LFP	60.5	0.04	32.2	159	<2	37	3.34	13	1.46	7.07	6.95	0.414	93
8/21/2018	NorthPond	108	0.04	36.7	25.9	<2	110	2.48	2	4.35	7.65	6.99	0.795	14
12/4/2018	BlacksNook*	45.75	0.01	14.55	18.05	20	19	12.52	55	0.27	7.315	7.7	0.04	9.5
12/4/2018	LFP	52.5	0.04	26.6	113	10.9	30	12.14	16	0.71	7.25	7.58	0.133	65
12/4/2018	NorthPond	106	0.03	37.3	25	11.1	143	1.35	27	6.4	6.87	7.21	1.4	14
2/6/2019	LFP	44	0.05	21.8	107	21.9	26	12.7	<1	0.48	7.65	7.85	0.045	64
2/6/2019	NorthPond	97	0.44	39.3	20.2	49	170	11.02	1	17.5	6.94	8.57	2.28	11
3/28/2019	BlacksNook	67	0.01	15.2	16.3	4.15	34	10.9	8	0.72	6.96	7.87	0.057	7

Anomalous data are highlighted in red. *Sample results are average of sample and field duplicate.



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Table 1: Water Quality Results cont.

Date	Site	NH ₃ (mg/L)	NO ₃ (mg/L)	Lab SpC (uS/cm)	<i>In situ</i> probe SpC (uS/cm)	Total Dissolved Solids (mg/L)	Water Temperat ure (degrees C)	TKN (mg/L)	Total Organic Carbon (mg/L)	Total Phosphor us (mg/L)	Turbidity (NTU)
4/24/2018	Blacks Nook	0.162	< 0.005	153	162.4	103.9	13.94	0.636	No data	0.0436	2.65
4/24/2018	LFP	0.111	0.239	519	568	363.5	13.78	0.742	No data	0.0351	2.65
4/24/2018	North Pond	0.143	< 0.005	276	297.4	190.3	14.57	0.949	No data	0.0478	5.04
8/21/2018	Blacks Nook	0.0808	< 0.05	142	162.6	104	22.81	0.569	5.4	0.0383	1.16
8/21/2018	LFP	0.0759	< 0.05	644	676.8	433.1	24.6	0.841	4.9	0.0436	5.02
8/21/2018	North Pond	0.14	< 0.05	274	298.4	191	22.66	1.42	15	0.0627	11.3
12/4/2018	Blacks Nook*	0.1038	< 0.05	143	161.8	103.6	4.41	0.51	5.1	0.02975	1.73
12/4/2018	LFP	0.246	0.485	463	521.5	333.8	4.58	0.772	4.5	0.0276	3.05
12/4/2018	North Pond	0.378	0.136	276	303.6	194.3	4.89	1.36	14	0.0914	8.37
2/6/2019	LFP	0.212	0.24	432	486.6	311.4	4.61	0.642	4.5	0.0298	2.33
2/6/2019	North Pond	0.773	< 0.005	246	205.7	131.6	1.45	4.23	12.2	0.2200	14.5
3/28/2019	Blacks Nook	0.0824	< 0.05	126	169.1	108.2	8.03	0.49	4.8	0.0436	2.75
*Sample results are average of sample and field duplicate.											